

Several other monuments, *e.g.*, Chûn Castle and Cromlech, are to be found in the immediate neighbourhood of the Tregeseal Circle and the Longstone,

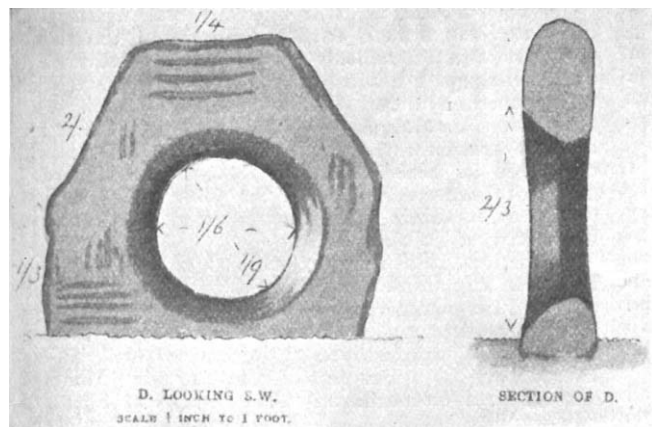


FIG. 7.—The Mên-an to'. Front view and section, from Lukis.

but these will have to await further investigation as to their character and antiquity before any conclusions concerning their astronomical use can be deduced.

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#### IRRIGATION IN THE TRANSVAAL.<sup>1</sup>

THERE are few subjects on which such a great diversity of opinion exists as on the administration of South Africa. Free labour and Chinese labour, the electoral franchise of the Transvaal, the various routes from the interior to the coast, the language to be adopted in Government schools—on these and on many other points one hears well-informed and perfectly honest-minded people asserting, and that with considerable warmth, the most opposite views; views which they maintain are founded on facts.

But there is one subject on which it may be asserted all are agreed, and that is that the great want of South Africa is not gold or diamonds, but water in sufficient volume to be spread over the land when and where it is required. Not that the country is generally devoid of rain, but, as it has been well put, "When rain is wanted it is generally not there; when it is not wanted it is invariably present."

No one was more fully alive to this want than the late distinguished High Commissioner, Lord Milner. He borrowed the services of Sir William Willcocks, one of the most prominent members of the small band of English hydraulic engineers from India who have done so much on the Nile. He further procured two engineers, Messrs. Gordon and Strange, thoroughly trained in the excellent irrigation school of India, to advise, one in the Cape Colony and the other in the Transvaal, upon irrigation matters. Willcocks's tour took place during the war, when he was much hampered by the difficulty of getting about the country. His visit, also, was a short one, but not too short to prevent his submitting a very able report full of thoughtful suggestions. Gordon and Strange went to South Africa after the war. They are there still, and may render invaluable services to the country if the agricultural classes can be made to believe that they have anything to learn, and that there may be advantages in accepting a scheme which requires all

to submit to certain restrictions for the benefit of all, instead of each farmer being free to follow his own devices. A distinguished member of the present Cabinet has remarked that the Boer farmer seems to have a perfect instinct for disobeying the law. Unless he learns to substitute for this instinct the dictates of reason, there is little hope of irrigation flourishing in South Africa.

Besides procuring the services of these officers, Lord Milner shortly before leaving South Africa appointed a commission to report on the legislation required to enable the water resources of the Transvaal and Orange River Colony to be thoroughly utilised, and also on "the precautions necessary in dealing with subterranean water, more especially in areas situated on the dolomite formation, so as to prevent as far as possible the diversion of such water from public streams and fountains to the detriment of the public."

It was directed that an interim report should be submitted as soon as possible on this last subject. This report, dated May 20, 1905, is now before us. The commission consisted of Mr. Justice Wessels, Judge of the Supreme Court of the Transvaal, three other Dutch and two English gentlemen, one of whom was Mr. Strange.

The commission has collected a large mass of interesting information and opinions from thirty-one witnesses, of whom no fewer than nine were professional geologists. South Africa is to be congratulated in possessing so many scientific gentlemen whose evidence was of great value. The other witnesses were principally engineers and farmers. Of the latter there were seven.

In framing an irrigation project the two first questions to ask are generally, How much land is it proposed to irrigate? How much water is available to irrigate it? In all but the most favoured countries the area which it is desired to water far exceeds the volume of water available. In the Transvaal the irrigable area can easily be marked out. It is not so easy to say how much water is at our disposal.

Usually irrigation is practised by canals and water-courses drawn from rivers and lakes, natural or artificial. By careful observation one finds how much water, at the season when irrigation is required, can be drawn from the river or lake. Elsewhere irrigation is practised by pumping water from wells, going down to the water-bearing stratum. Such a stratum is usually found in alluvial plains at no very great depth, and wells may be sunk within a few hundred yards of each other without causing injury by one exhausting the other. The recent Indian Irrigation Commission found that in that country about 13 millions of acres were yearly watered in this way.

The peculiarity of the situation on the dolomite formation of the Transvaal is that the subterranean water tapped by the boring rod is not due to the rain which falls vertically on the surface of the land above, but that the whole of the limestone substratum is pierced by holes and tunnels, flowing streams, and stagnant reservoirs, so that if water be pumped from a well there is no certainty that another well situated ten miles off may not be thereby sucked dry.

Ultimately the water finds its way out to the surface through springs discharging at times more than 50 cubic feet per second. It seems evident that the catchment basins of these subterranean waters do not necessarily correspond with those of the earth's surface above, and the problem of defining their limits and

<sup>1</sup> "Inter-Colonial Irrigation Commission." Interim Report. Pp xxxvii +166. (Pretoria: Government Printing and Stationery Office, 1905.) Price 7s. 6d.

calculating the volume of the water that may be drawn from them is not an easy one. Nor is it rendered more easy by the spirit evinced by the Boer farmer witnesses.

Three of the honoured name of Erasmus (two brothers and the son of one of them) refused to recognise any difference between the ownership of water flowing under his ground and of metals found there. Pressed again and again to see the difference between picking up a diamond found on his lands and pumping away the water drawn in from the lands of others, the reply of one of the farmers was quite clear:—"I consider that it is a bad principle when a man owning land under a properly registered title in any country cannot take full advantage of the profit he is able to make."

Not only did these farmers claim the right to use all the water they could suck into their pumps and employ in irrigating their own lands, but they also insisted on their right to sell to their neighbours the water they did not require themselves.

It might happen, then, that the owner of a small pump large enough for his own fields might find his water supply cut off by a larger pump in his neighbour's farm, and he might have to buy from the owner of this large pump the water that had hitherto been his own.

The situation is evidently a difficult one. If such a case were to occur in India it would probably be ruled that a very careful scientific survey should be made of all the subterranean channels with the view of finding exactly how the waters flow, and that until this point was cleared up farmers should have a restriction put on the area of their lands which they were allowed to irrigate. Probably no one would be wronged if they were each limited to irrigating two-thirds of their farms. But this would require a stronger Government than is ever likely to rule in the Transvaal. Probably the commissioners are right in the recommendations they make, and they know that none more drastic would have a chance of being adopted.

These recommendations, after providing for the wants of towns and of mine owners, are to the effect that farmers should be allowed to pump freely for their own use for watering cattle or for irrigation.

"That traffic in underground water should be prohibited, and that an owner should not be allowed to sell or barter underground water which he does not require for his own use." "That it is unnecessary to prove that water in the dolomite formation flows in channels . . . and that if the Judge thinks that the facts establish a connection between the pumping and the diminution of the water in a stream he can prevent the pumping to such an extent as he thinks fit."

This last recommendation is a most important one. Will the Transvaal judges have the courage to carry it into effect?

Since the above was written, an interesting notice has appeared in *NATURE* of March 1 (p. 426). From this it seems that the subject of underground waters has been occupying attention in the United States. The law there seems to favour the view of the Boer farmer, viz., that the owner of the surface of the land is equally owner of all that lies directly below that surface, whether it be rock, stagnant water or running water. This law is, however, receiving severe shocks from the advance of geological knowledge, and as means have now been found of measuring the flow of subterranean water it is probable that the law may be conformed to what is clearly only justice, and a landowner will not be permitted to take more than his due share of the water that passes under his soil.

#### THE FORTHCOMING MEETING OF THE BRITISH ASSOCIATION AT YORK.

THE fourth meeting of the British Association in York will be held in that city on August 1-8, the date being fixed earlier than usual to enable members and their hosts to combine attendance at the meeting with a subsequent tour abroad or a visit to the northern moors for the shooting season. The association was founded in York in 1831, and had for its first president the Earl Fitzwilliam, F.R.S. It celebrated its jubilee there in 1881, under the presidency of Lord Avebury, then Sir John Lubbock, and it now meets again, after three-quarters of a century, in the city of its birth.

At the inaugural meeting on Wednesday, August 1, Prof. E. Ray Lankester, F.R.S., president-elect, will assume the presidency and deliver an address. On Thursday, August 2, there will be a soirée; on Friday, August 3, a discourse on "Volcanoes" will be delivered by Dr. Tempest Anderson; on Monday, August 6, a discourse on "The Electrical Signs of Life, and their Abolition by Chloroform," will be delivered by Dr. A. D. Waller, F.R.S.; on Tuesday, August 7, there will be a soirée; and on Wednesday, August 8, the concluding meeting will be held.

The sections and their presidents are as follows:—(A) *Mathematical and Physical Science*, Principal E. H. Griffiths, F.R.S.; (B) *Chemistry*, Prof. Wyndham Dunstan, F.R.S.; (C) *Geology*, Mr. G. W. Lamplugh, F.R.S.; (D) *Zoology*, Mr. J. J. Lister, F.R.S.; (E) *Geography*, Sir G. D. Taubman Goldie, K.C.M.G., F.R.S.; (F) *Economic Science and Statistics*, Mr. A. L. Bowley; (G) *Engineering*, Dr. J. A. Ewing, F.R.S.; (H) *Anthropology*, Mr. E. Sidnev Hartland; (I) *Physiology*, Prof. Francis Gotch, F.R.S.; (K) *Botany*, Prof. F. W. Oliver, F.R.S.; (L) *Educational Science*, Prof. M. E. Sadler.

To the antiquarian York has preeminent attractions, its Roman remains, its mediæval bars and walls, which still encircle the greater part of the city, its Norman castle and noble minster, being each objects of special interest. The city also contains several manufactories interesting to scientific men; opportunities will be given for visiting these under skilled guidance in the afternoons, after the meetings of the sections. Excursions will be organised to several places of interest.

The neighbourhood of York, though flat, presents many objects of geological and archæological interest, many of which are reached by good level roads; cyclists are therefore recommended to bring their machines with them to the meeting.

It is hoped that it may be possible to arrange for an exhibition of photographs taken by the members in South Africa, for which the reception room affords ample accommodation.

York enjoys exceptional railway facilities, being under four hours from London, five hours from Edinburgh. The various railway companies will issue return tickets, at a single fare and a quarter, from the principal stations in the United Kingdom to York. These tickets, which will be available from July 31 to August 14, may be obtained by members and associates attending the meeting on presentation of a certificate signed by one of the local secretaries. The North-Eastern Railway Company will also issue periodical tickets to members and associates, at cheap rates, for going and returning as often as desired during the time of the meeting between York and the chief places in the district.

An attempt may be made, provided sufficient support is forthcoming, to arrange at the end of the meeting a yachting excursion, lasting two or three weeks, to